NASA Activities

National
Aeronautics and
Space
Administration

September 1982
Vol. 13, No. 9

About the Cover

Nearing completion at NASA's Ames Research Center, Mountain View, Calif., is an addition to the world's largest wind tunnel which will nearly double its size. The resultant tunnel, known as the National Full-Scale Aerodynamics Facility, will actually be two tunnels: the existing 40 × 80 foot section and the new test section measuring 80 × 120 feet in cross section, large enough to test a medium size commercial transport with engines running. This new test section terminates in a new air intake that measures 132 feet (13 stories) high and 362 feet wide (cover photo). The single drive to be used for both tunnels is being increased from the former 36,000 horsepower to 135,000 hp by six huge 22,500 hp electric motors. Top speed for air flow in the 40 × 80 foot tunnel will be 345 mph. The new facility is expected to be operational in December.

Below, is an aerial view of the Ames 40 × 80 foot wind tunnel (upper left in photo) retouched by a NASA artist to show the new larger test section (right of photo).

Corrections: In the June 1982 edition of *NASA Activities,* the following items need correction. Page 19, right column, line 4 should read: Launched Feb. 4, 1970 from the Western Test Range, Calif., the Cleveland-developed SERT II . . ." Page 26, left column, line 24-25 should read: "Weighing 10,000 kilograms (11 tons) . . ."

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NASA Activities is published monthly by the National Aeronautics and Space Administration for the information of the Agency's employees.
Contributions and recommendations are solicited from headquarters and field centers, and should be addressed to the Office of Public Affairs, Code LFD-10, Washington, D.C. 20546.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

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NASA Technology May Help Third World Nation Avert Energy Crisis

NASA technology in alternative energy sources may help a third world nation better survive an impending energy crisis.

For Tunisia, North Africa, it is predicted that the country's known reserve of crude oil will no longer meet their demands by 1990. Tunisia relies on petroleum to produce electricity. The projected shortage would force the nation to become a net importer to meet their growing needs. However, a new test program begun between Tunisia, NASA and the U.S. Agency for International Development could change this bleak energy picture.

Construction has begun on one of the largest village stand-alone solar power systems in the world, at a small settlement 150 kilometers (93 miles) southwest of the Tunisian capital of Tunis in Northeast Africa. NASA's Lewis Research Center, Cleveland will manage the project funded by the Agency for International Development and the government of Tunisia. AID will underwrite three fourths of the $1.9 million cost, and the government of Tunisia will pay the remaining one fourth.

The village, known as Hammam Biadha, will be provided with solar electricity as part of an ongoing, five-year-old photovoltaic power systems program sponsored by the Agency for International Development and managed by Lewis. Objective of the international effort is to investigate the feasibility of photovoltaic power systems as cost-effective alternatives to petroleum-based electrical systems in remote areas.

Prime contractor on the project is Solar Power Corp., Woburn, Mass., and a lead subcontractor is Tri-Solar Corp., Bedford, Mass.

The main solar electric system will provide photovoltaic power to a central installation for indoor lighting, street lighting, refrigeration, radio, television and water pumping for the village. Two smaller, remote installations will provide for

Artist concept of one of the world's largest stand-alone solar power systems currently being constructed in a small settlement 150 kilometers southwest of the Tunisian capital of Tunis in Northeast Africa.

agricultural applications on a nearby farm and orchard. In total, the systems will be capable of 25 to 30 peak kilowatts of usable electricity. All solar electric systems are expected to be in place and operational by October of this year.

In addition to the photovoltaic power systems, two small wind turbines will be installed to pump water for the irrigation of two greenhouses. Also, two small solar heating systems will be supplied, one providing hot water for the village clinic, and the other providing warmth for the clinic examining rooms and nurses' living quarters.

Centerpiece of the main photovoltaic power system is the array of 30,240 wafer-thin solar cells which can convert the rays of the sun directly into usable electricity. The 100-millimeter (4-inch) diameter cells are encapsulated into 840 modules, each measuring approximately 1.20 by .45 meters (3.9 by 1.5 feet). Each module contains 36 solar cells and produces 31 watts of peak power at 12 volts dc. Peak power is produced in full sunshine with the sun's rays striking the solar cell at a 90-degree angle or perpendicular to the surface of the cell.

Hammam Biadha is composed of three sectors: a public sector which includes a school for 400 children, a mosque, a clinic, and a public water well; a commercial sector composed of two retail stores, a new barber shop, and a grain mill; and a residential sector which provides living quarters for the town's 60 residents.

According to Lewis Research Center's Larry R. Scudder, project manager of the Tunisian Renewable Energy Project, "the goal is to investigate the economic, social and technical value of alternative energy resources and technologies in assisting development and improving the quality of life in Tunisia. The project demonstrates international cooperation in the use of space technology and its potential benefits to mankind."

Increased Durability Sought in Jet Engine Components

A project designed to increase the durability of jet turbine engines and thereby reduce maintenance costs is underway at NASA's Lewis Research Center, Cleveland. The project will focus on the hot section components of advanced U.S. built jet turbine engines and will channel its efforts in five major areas: structural analysis, surface protection, combustion, turbine heat transfer and instrumentation.

The $45 million Turbine Engine Hot Section Technology Project will be conducted over a seven-year period. To implement this research, between 25 and 30 contracts will be awarded to competing companies; approximately 50 percent of the research will be performed directly by NASA Lewis in-house staff. Lewis is NASA's lead center for aeronautical propulsion research.

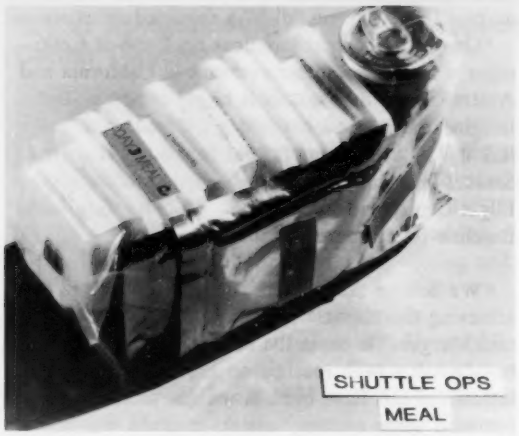
The hot section of a turbine engine is located near the aft portion of the powerplant. It includes both the combustor, in which fuel ignites in combination with pressurized air, and the turbine, located immediately aft of the combustor, which drives the inlet fan and the air compressor system. Components targeted for study are the liners of the combustor, and the blades and vanes of the turbine.

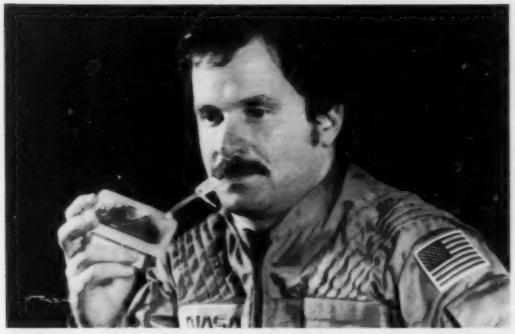
"Improvements that have led to increased efficiencies for the turbine engine have resulted in hot section parts being exposed to higher temperature and pressure levels," explains NASA Lewis project manager Daniel J. Gauntner. "These higher levels produce an operating environment increasingly hostile to those parts in the hot gas flow path. These hot section components account for only 20 percent of the engine's weight, but nearly 60 percent of its maintenance cost." Refining the basic turbine engine concept to create a lighter, quieter, cleaner, more fuel-efficient and less costly powerplant has been a goal of aeronautical engineers and designers for the past three decades.

During the 1950s and early 1960s jet engine designers aimed at improved performance and lower engine weight. In the late '60s and early '70s, demands for less noisy engines and cleaner emissions were added to the performance and weight goals. Today, designers working on the next generation of "energy-efficient engines," are advancing those initial objectives with the added responsibility of lowering fuel consumption, reducing manufacturing costs and increasing engine durability.

"All of these goals have or are being achieved to some extent," says Gauntner, "but their fulfillment is creating greater wear and tear on the hot section components of the engine. The result has been engine maintenance costs that are becoming an increasingly larger part of total airline operating costs."

Initial thrust of the project is to improve the understanding of interacting factors which lead to component damage and failure, then quantify and describe them. Finally, researchers must be able to predict how and when damage could occur.





Space Shuttle Meals—For operational Space Shuttle flights which begin this November, astronauts will use a newly designed meal storage and preparation system. At top left is closeup view of stowed Space Shuttle food items. Astronauts take the individual packets from the overall package and place them in a six-compartment tray (bottom left photo) for preparation and consumption. This meal is a Day 3, Meal C, tray consisting of smoked turkey, mixed vegetables, cream of mushroom soup and strawberries. First flight for this food storage arrangement and tray is the fifth flight in November. At top right is a closeup view of the rehydration unit to be used in meal preparation on operational Shuttle flights. The unit is located on the middeck of Columbia and Challenger. A Shuttle meal tray can be seen at upper right in this photo. At lower right, Mike Fohey of Technology, Inc., demonstrates how a Shuttle astronaut on an operational mission would drink a beverage. After rehydrating the dried powder with a needle, the Shuttle crew member would pick up the removable tray compartment and hold it like a cup or glass and drink through the straw-like tubing.

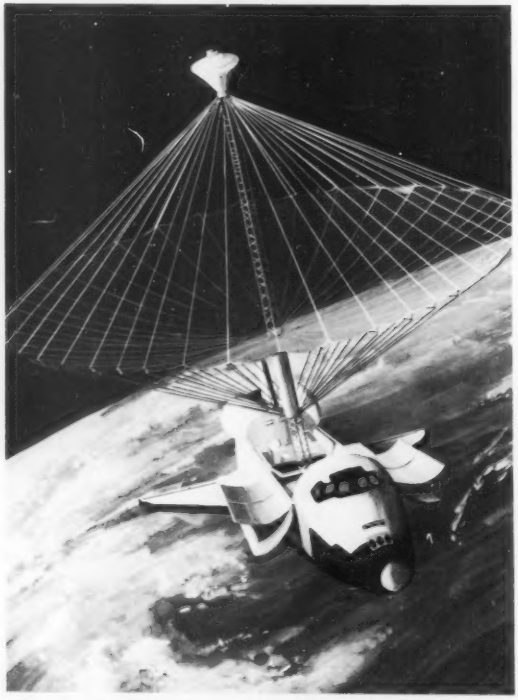
Closeup View of Universe Possible by 1990s

By the next decade, a future NASA project in radio astronomy could be providing detailed coverage of the universe. The Very Long Baseline Interferometer, a system linking a large orbiting radio astronomy antenna to one or more antennas on Earth, could provide resolution greater than one milli-arc-second—approximately the angle of view a person in Los Angeles would have of a dime placed in New York.

A working group on this project was chartered in 1981 by NASA's Office of Space Science and

Applications to develop the rationale and technical plan for placing an interferometer in space. The group has proposed sending into orbit an interferometer experiment aboard the Space Shuttle in the late 1980s.

A long baseline interferometer is a system of antennas, placed thousands of miles apart, that simultaneously study radio frequencies emanating from the heavens. This linkage of antennas makes possible high-resolution images of celestial sources that can't be achieved with a single, independent radio astronomy antenna. The signals received by each antenna in an interferometer system are recorded and synchronized by extremely accurate atomic clocks. These signals are later added together in a special way to produce radio images of the celestial sources being studied. The longer the distances, or "baselines," between the antennas, the larger the effective telescope diameter. Two radio telescopes, placed a thousand miles apart, in effect make a radio antenna "dish" a thousand miles across.



Artist's concept of a prototype antenna to be used in a radio astronomy system known as a Very Long Baseline Interferometer tested aboard the Space Shuttle. Such an experiment has been proposed for the late 1980s, with a permanent operational system in orbit by the late 1990s.

"One of the longest baselines on Earth is 6,600 miles with interferometer antennas in California and Australia, and that system is highly sensitive. But imagine the resolution you'd get if you were to link it with an antenna far out in space," said Dr. Samuel Morgan, physicist at NASA's Marshall Space Flight Center and study manager for the Very Long Baseline Interferometer project.

"We believe that space is the only answer to achieving the ultimate potential of radio astronomy," said Morgan, "because the maximum length of baselines has been reached on Earth. Ground-based interferometers have been in use for years and have provided some exciting insights into the universe such as quasars, enormously powerful objects of radiation far out into space, possibly at the edge of the universe. According to Einstein's special theory of relativity, the speed of light is the ultimate speed that can be achieved. However Earth-bound interferometers have suggested that certain components of some quasars studied split off from the main bodies at velocities that appear to exceed the speed of light. Scientists are intrigued by this kind of interesting puzzle. By extending the length of the interferometer baseline into space with an Earth-orbiting antenna closer study of these anomalies is possible.

An interferometer system in space would provide not only greater resolution but a much larger viewing area. Antennas are generally placed only on temperate-zone land masses where scientific activities are concentrated. Since most of the heavy science interest in the world is found in the United States, Europe and Asia, which occupy only the northern hemisphere, only east-west separations of antennas exist. Limited science activities on relatively limited land masses in the southern hemisphere make north-south separations of antennas—with the additional views of the heavens they could offer—virtually nonexistent. A space-based interferometer in a 5,000-kilometer orbit, however, would overcome that problem.

"Ultimately we would like to place an interferometer about 200,000 kilometers out, which would give us a radio astronomy capability that far exceeds what we have today," said Morgan. "An interferometer placed that far from Earth may be possible by the turn of the century."

Griffin Assumes Post as Johnson Space Center Director

Gerald D. Griffin, has assumed the post of Director, Johnson Space Center, Houston in August. Prior to returning to NASA in June 1982, Griffin was Vice President for Systems Engineering and Management, Scott Science and Technology, Inc., Lancaster, Calif. He previously served with NASA from 1964 to 1981. From 1977 to 1981, Griffin was the Deputy Director of the Kennedy Space Center, Fla. From July 1980 to June 1981 he concurrently served as Associate Administrator for External Relations at NASA Headquarters in Washington.

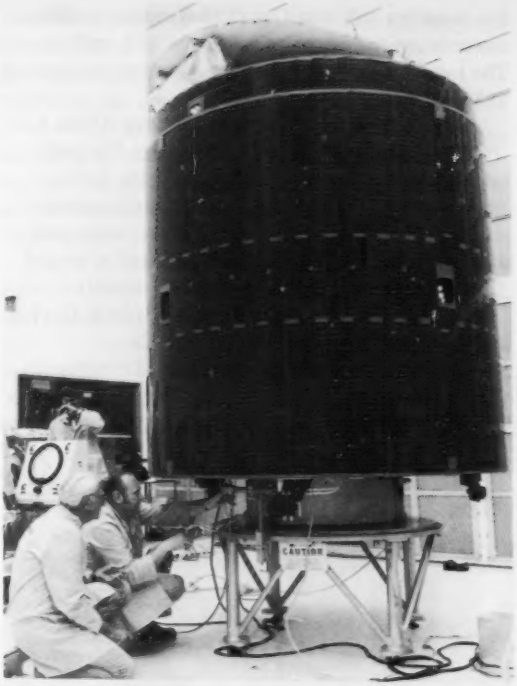
Griffin was Deputy Director of the Dryden Flight Research Center, Edwards, Calif. from 1976 to 1977. At NASA Headquarters he was Deputy Associate Administrator for Manned Spaceflight (Operations) from 1975 to 1976, and from 1973 to 1975 served as Assistant Administrator for Legislative Affairs.

Prior to his first Headquarters assignment, he was a flight director in Mission Control on all 11 Apollo missions. He served as lead flight director on Apollos 12, 15 and 17. He was also involved in all of the Gemini flights as a flight controller. He joined the NASA Johnson Space Center (then the Manned Spacecraft Center) in 1964.

Griffin received a bachelor's degree in aeronautical engineering from Texas A&M University in 1956 and served four years as an officer in the U.S. Air Force. He was an aerospace engineer with Douglas Aircraft Co., the Lockheed Missile and Space Co., and General Dynamics before joining NASA.

NASA Signs Launch Agreements for Five Canadian Satellites

NASA and Telesat Canada, the operator of the Canadian domestic telecommunications satellite system, have signed launch services agreements for the launching of Telesat's ANIK satellites. Under these agreements, NASA will launch five telecommunications satellite payloads, four on the Space Shuttle and one on the Delta launch vehicle. These



Technicians perform prelaunch checkout (top photo) of Telesat-G (Anik D-1) spacecraft, launched from NASA's Kennedy Space Center Aug. 26 aboard a Delta expendable launch vehicle. Launch of Telesat-G at 7:10 EST (bottom photo).

five launches will cost Canada's domestic satellite communications corporation about $75 million. The satellites themselves will be worth approximately $130 million.

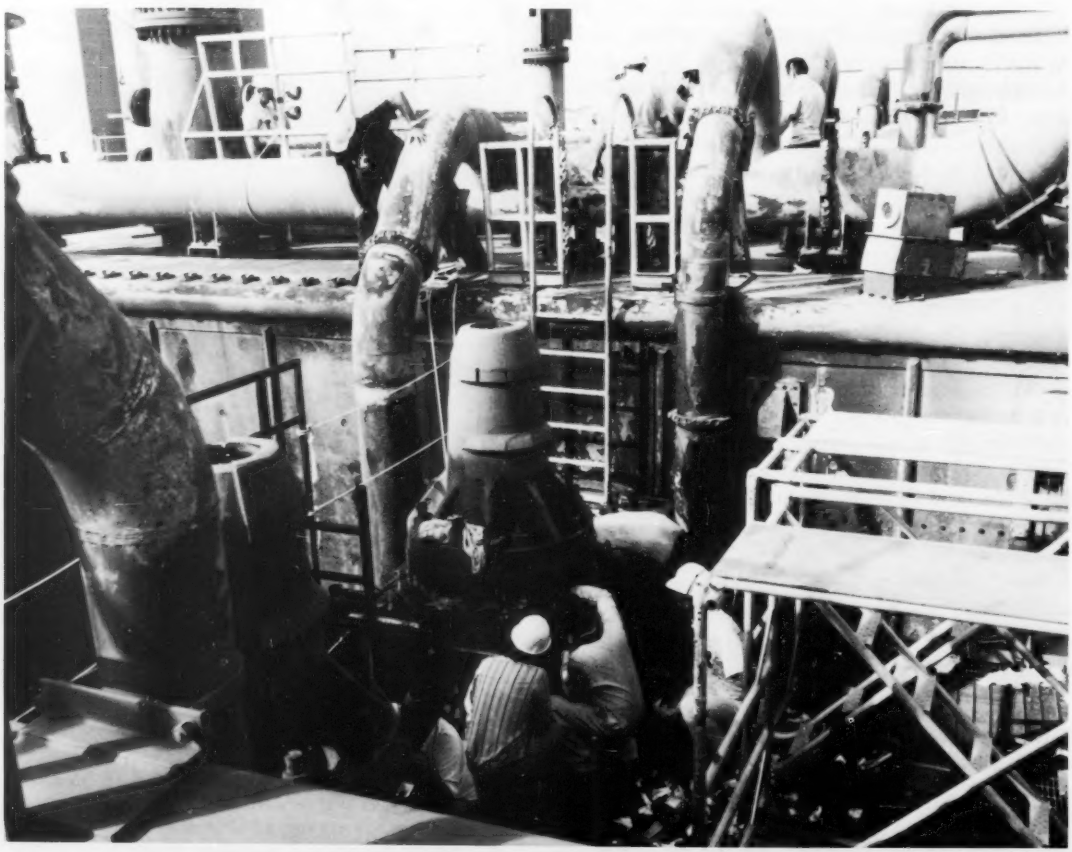
Telesat's third and fourth generation ANIK C and D satellites will be the backbone of Canada's satellite communications system until the 1990s. They will carry new pay TV and other broadcasting services, as well as point-to-point voice, video and data links, private business networks and a host of other specialized telecommunications services.

The first of the D series, Telesat-G (Anik D-1), was launched August 26 from NASA's Kennedy Space Center, Fla., aboard a Delta launch vehicle. The next Telesat launch, Telesat-E (Anik-C1), will be one of two commercial communications satellites launched by the Space Shuttle on its fifth flight in November.

The agreements were signed at the Telesat Canada headquarters in Ottawa, Ontario, Canada, by Dr. Stanley I. Weiss, Associate Administrator for Space Transportation Operations for NASA and Eldon D. Thompson, President, Telesat Canada.

NASA, German Research Ministry Sign Cooperative Mission Agreement

A memorandum of understanding has been signed in Vienna, Austria, by James M. Beggs, NASA Administrator, and Hans-Hilger Haunschild, State Secretary, German Federal Ministry for Research and



Pre-launch Activity—Workers refurbishing mobile launcher platform #1, used for assembling and launching the first four Space Shuttle vehicles. This platform also will be used for the fifth liftoff now scheduled for Nov. 11.

Technology (BMFT), establishing cooperation on an astrophysics mission designated Roentgensatellit (ROSAT). ROSAT is scheduled to be launched by the Shuttle-based Space Transportation System in 1987.

The ROSAT mission will advance astrophysics through the study of X-ray emissions from non-solar celestial objects with an X-ray observatory which will survey the sky for X-ray sources and will point at specific sources for extended periods of time.

The main instrument of the observatory will consist of a Wolter type I X-ray telescope with a carousel focal plane assembly carrying two imaging proportional counters and one high resolution imaging detector. The main telescope will be supplemented by an XUV wide field camera which is oriented parallel to it.

The ROSAT project will be carried out as a cooperative venture between NASA and BMFT. BMFT will provide the ROSAT spacecraft and the X-ray telescope and NASA will provide a high resolution imaging detector and Space Shuttle launch services. The Science and Engineering Research Council of the United Kingdom will provide the XUV wide field camera.

The ROSAT will operate in both a survey mode and a pointed mode. The BMFT will compile an X-ray source catalog from the data obtained during the survey portion of the mission. NASA and BMFT will each invite proposals from the scientific community to carry out investigations during the pointing phase of the mission.

Goddard Space Flight Center, Greenbelt, Md., and the German Aerospace Research Establishment (DFVLR) are responsible respectively for management of the U.S. and the German portions of the program.

ROSAT, in addition to the Galileo and Active Magnetospheric Particle Tracer Explorer missions, are current examples of a long history of successful cooperative projects between NASA and BMFT.

Inspector General Activities

The following reports are of completed recent investigations by NASA's Office of the Inspector General.

Possession of Alleged Lunar Materials

After receiving information from the curatorial branch at NASA's Johnson Space Center, Houston, the Office of the Inspector General opened an investigation of the proposed sale of so-called moon dust. In an article in the *Wall Street Journal*, a private citizen offered to sell a small amount of white powder for $75,000. The broker claimed to be marketing the dust for individuals who had purchased it in 1974 in Delaware. The substance was described as lunar dust vacuumed from space suits during a specific post-flight cleaning and examination process conducted by the suit manufacturer in Delaware.

The Office of the Inspector General reviewed relevant documents and inventory records and interviewed key personnel responsible for the post-flight examination of flight equipment. This process verified the space suits never left the flight center to be cleaned at the Delaware site. All post-flight examinations of the suits took place at the NASA flight center. Furthermore, no discrepancies were identified in the accountability procedures at the flight center for handling lunar material. Since no theft or loss occurred, efforts by the Office of the Inspector General did not extend beyond this assurance level.

Procurement Violation

Recent investigation at a NASA Center identified a contractor employee who violated procurement practices by disclosing cost estimates of NASA construction projects to another contract bidder. Within one week, effective collaboration by NASA management and the Office of the Inspector General resolved the problem. The contract employee was terminated, and the contractor who received the information was declared a "non-responsible bidder."

Existence of Polar Wind Proven by NASA Satellite

Flow of particles from the ionosphere into space, a phenomenon called the polar wind and theoretically predicted over a decade ago, has been recorded for the first time by instruments aboard NASA's Dynamics Explorer satellite. Called Retarding Ion Mass Spectrometers, these instruments were specially designed to seek out the polar wind.

The spacecraft carries three spectrometers, one on each end and one mounted on the side to scan as the satellite spins about its axis. This enables the satellite to "see" in all directions and to sample gas hitting the satellite from the side facing the Earth. Plasma from this direction is the polar wind.

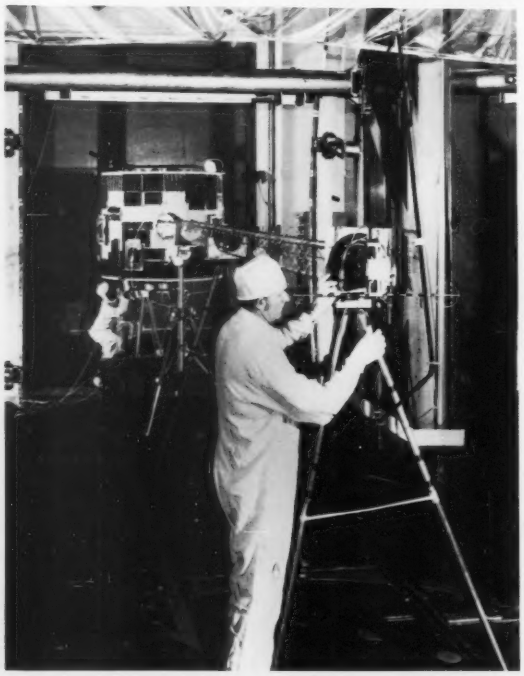
Data recorded by the spectrometers prove that there is a continual interchange of particles from one part of the Earth's near-space environment to another so that neither the ionosphere nor the magnetosphere can be understood in isolation.

The Dynamics Explorer program is designed to provide new knowledge about the exchange of energy, electric currents, electric fields and charged particles in the magnetosphere, ionosphere and atmosphere.

Dynamics Explorer flies an elliptical orbit over the Earth's poles. The highest point of the satellite's orbit is approximately 22,000 kilometers (14,000 miles or 3.5 Earth radii), well into the region of the inner magnetosphere dominated by high energy plasma. At lower points in its orbit, the satellite passes through the cooler, lower energy plasma of the ionosphere and plasmasphere.

A companion satellite, Dynamics Explorer 2, is in a lower polar orbit for coordinated studies of plasma and the aurora.

Twenty-five years ago when gases of charged particles were first discovered in the Earth's space environment, the question arose on the source of the plasma. For a long time, it was thought the magnetosphere contained only very high-energy hydrogen and helium particles that came from the Sun via the solar wind. Improved instrumentation led to the discovery in 1970 of high-energy oxygen ions in a form not produced by the Sun. This finding suggested that some constituents of the magnetosphere must come from within the Earth's environment, from the ionized upper atmosphere.



Dynamics Explorer 1, undergoing preflight checkout. Launched August 1981, data from this spacecraft has proven the existence of polar wind—the flow of plasma from the ionosphere into space.

One generally accepted theory, proposed by Dr. Peter Banks and Dr. Thomas Holzer in 1969, explained how the ionosphere could feed plasma into the magnetosphere. They calculated that small electric fields in the polar regions could drive particles up the magnetic field lines. This acceleration might give ions just 1 electron volt (eV) of energy, but that is enough to set a hydrogen ion moving at about 14 kilometers per second (31,000 miles per hour). These scientists named the flow of gas from the ionosphere into the space the polar wind.

Banks with coinvestigator Dr. C. R. Chappell of NASA's Marshall Space Flight Center, Huntsville, Ala., developed Dynamics Explorer's spectrometer. The necessary requirements were the capability to do mass discrimination at very low energies of 0-50 eV, to see in all directions, and to offset the effects of spacecraft charging.

In the past, instruments capable of good mass resolution of low-energy ions were flown only in the ionosphere. Instruments flown in the magnetosphere looked only for ions in the high energy range from tens of electron volts to 10,000 eV and were not capable of subtle mass separation. Dynamics Explorer carries state-of-the-art mass spectrometers to higher altitudes than ever before.

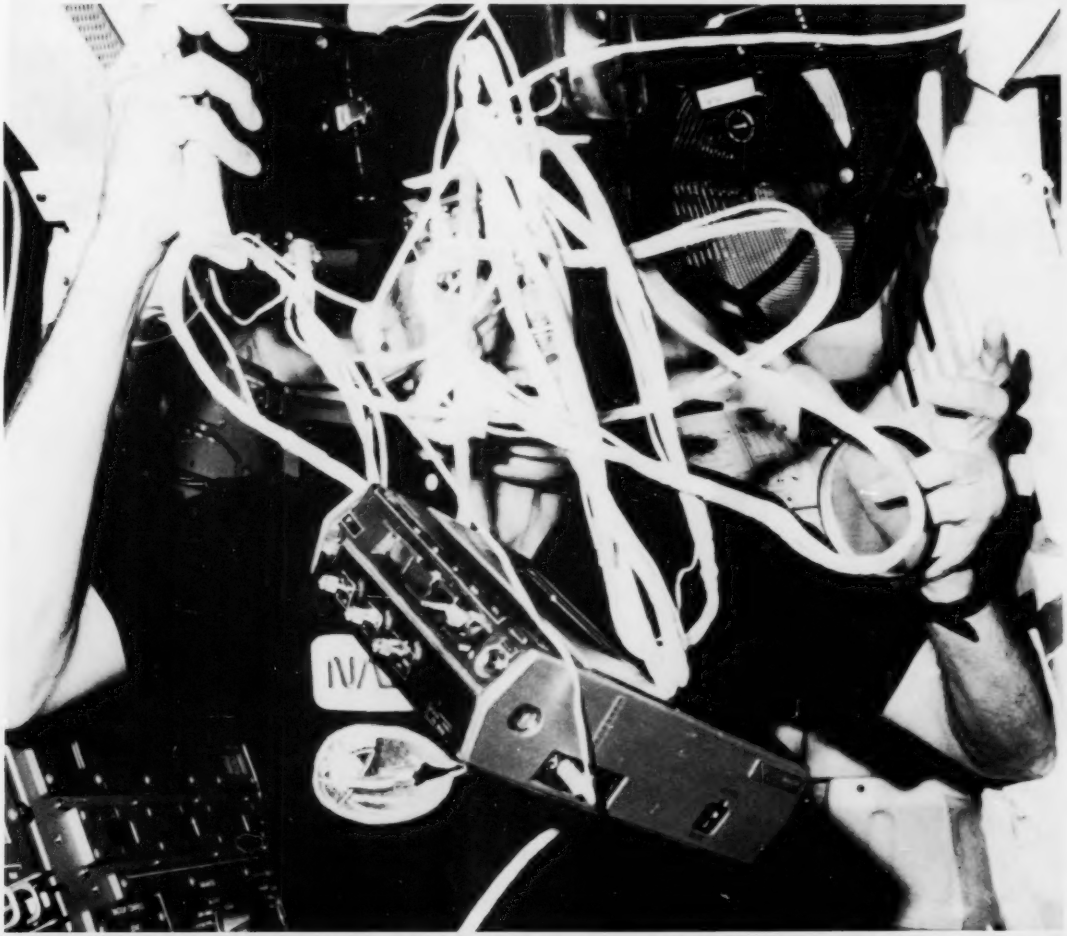
Normally, satellites at high altitudes develop a positive electrical charge of a few volts that repels positively charged ions. Thus, an instrument cannot detect low-energy ions unless the spacecraft's charge is neutralized. Chappell and his colleagues overcame this difficulty by applying a small negative charge to a gold disk around the opening of the spectrometer sensor. This neutralized the spacecraft's charge, and the spectrometer readily detected low-energy ions. It also detected a very high ion flux over the polar regions, where the polar wind had been predicted to originate.

The spectrometer saw hydrogen and helium ions flowing upward at the predicted speed of about 10 km per second (22,000 mph). Surprisingly, the instruments also saw ions streaming out above the polar

cap at much higher speeds than expected, up to 50 km per second (112,000 mph). Scientists are not yet sure about the origin and cause of this unexpected phenomenon. Though the Dynamics Explorer observations confirm the existence of the polar wind, many unanswered questions remain. How does the polar wind supply ionospheric particles to the distant magnetosphere? What part does the polar wind play in the Earth's complex responses to the changing Sun?

The polar wind is another fundamental factor in the study of solar-terrestrial interactions. The Dynamics Explorer satellite and spectrometer instruments are expected to function for a year or more. Further measurements and analysis should give new insight into the role of particle acceleration and energy transfer throughout the Earth's space environment.

The Dynamics Explorer is managed for NASA's Office of Space Science and Applications by the Goddard Space Flight Center, Greenbelt, Md.



Space Spaghetti—Astronaut T. K. Mattingly, commander of the fourth Space Shuttle mission, loses his cap amidst a maze of wiring ("space spaghetti"), tape recorder and camera equipment floating in the weightless environment onboard the Columbia. This 35-mm photo was exposed by astronaut Henry Hartsfield, fourth Shuttle mission pilot. The pair spent seven days in space for NASA's final orbital test flight.

NASA at the World's Fair—Scenes from NASA's exhibit (this page and opposite) at the World's Fair in Knoxville, Tenn., May 1 to Oct. 31. The 4,000-square-foot exhibit, on display in the Technology and Life Style Pavilion, focuses on "future uses and the role of the Space Shuttle. July was "Shuttle Month" at the Fair. Over one million people will have viewed the NASA exhibit by the Fair's end.

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Contractor News

Hamilton Standard Div., United Technologies Corp., Windsor Locks, Conn., has been awarded a $7,451,000 contract by NASA's Lewis Research Center, Cleveland, to supply large-scale propeller assemblies for a potential future flight program. Under a separate contract, a major airframe manufacturer and an engine manufacturer will work with Hamilton Standard. NASA's advanced turboprop research is aimed at developing technology for advanced, high-speed propellers suitable for use on future civilian and military aircraft. Fuel savings of 15 to 20 percent over current turbofan engines is expected.

Phase I of this two-phase contract includes: building a .6-meter (2-foot) diameter aeroelastic propeller model; design and fabrication of a large-scale 2.7-m (9-ft.) diameter propeller assembly with fixed pitch, ground-adjustable blades; and static and high speed wind tunnel tests of the large-scale blade and assembly. Phase II, which will begin at government discretion upon receipt of program authority and funding, would amount to $13,990,000. It would include delivery of three additional large-scale 2.7-m (9-ft.) diameter, variable-pitch rotor assemblies plus additional static and wind tunnel tests. In addition to these two phases, an optional $3,752,000 may be awarded for two more 2.7-m (9-ft.) diameter propeller assemblies designed to rotate opposite to those from phases I and II. If Phase II and the option are conducted, the entire program could run for five years. The work will be performed at Windsor Locks.

Boeing Services International, Cocoa Beach, Fla., has been awarded an extension to its contract to manage ground systems operations for NASA at Kennedy Space Center. The one-year extension is valued at $46.7 million and continues Boeing's contract until June 30, 1983. Six one-month options totaling $32.8 million also could be added to the contract. Under the terms of the contract, Boeing will continue to support NASA and the Space Shuttle program by providing installation of ground support equipment, modification of launch systems, operations and maintenance services for specific Space Shuttle support activities, operation and maintenance services for Kennedy facilities, and maintenance of launch systems.

Boeing's ground systems operations contract will be phased out by two new contracts at Kennedy. The ground systems contract covers the 1,500 BSI workers until November 1982. At that time, NASA's new base operations contract, now in competition, will combine some of Boeing's ground systems work with all or portions of other support service contracts at Kennedy. Award of the base operations contract is expected to be made in October. The remainder of Boeing's ground systems work force will continue their roles until July 1983 or until a new shuttle processing contract (see Contract News, Aug. edition of *NASA Activities*) will combine this remaining ground systems work with other Kennedy contracts.

Four companies have submitted proposals for a **base operations contract,** the first of three comprehensive contracts to be awarded by NASA's Kennedy Space Center, Fla., to strengthen the Space Transportation System launch function. The base operations contract will cover institutional support services, now provided by 13 different contractors, into a single mission contract which includes utilities, facilities, administrative services, technical operations, and health and protective services. The contract could cover a period of as many as 10 years and involve expenditures of more than $500 million over the life of the contract.

Proposals, opened June 17, were received from: **BENKO Joint Venture** (Bendix Field Engineering, Wackenhut Services, Inc., Planning Research Corp. and Computer Sciences Corp.), Cape Canaveral, Fla.; **Boeing Services International,** Cocoa Beach, Fla.; **EG&G,** Wellesley, Mass.; and **Lockheed Engineering and Management Services Co., Inc.,** Houston. The proposals are under review at Kennedy and a source selection may be made by early October. It is projected the base operations contract winner would begin work about mid November. The contractor selected would be fully responsible for management, operation, maintenance and engineering for Kennedy Space Center utilities, facilities, certain technical and administrative operations and health, fire and security services.

This is the first of three comprehensive contracts that NASA plans to establish at Kennedy as the most effective and economical method of conducting Space Shuttle missions when the system becomes operational. The other two single mission contracts will be a Shuttle Processing Contract responsible for refurbishment, assembly, checkout and launch of the Space Shuttle, and a Cargo Processing Contract.

Patents for Inventions from NASA Research

The Office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent and Trademark Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

Inventor(s) and Employer	Title	Patent No.	Installation
Archibald L. Fripp, James B. Robertson and Roger A. Breckenridge, NASA/LaRC	Pyroelectric detector arrays	4,341,012	LaRC
William A. Brainard, NASA/LeRC	Improved refractory coatings	4,341,843	LeRC
John C. Evans, Jr., An-Ti Chai and Chandra P. Goradia, NASA/LeRC	High voltage planar multi-junction solar cell	4,341,918	LeRC
George D. Doland, Lockheed Electric Co., Inc., Houston	Secure communications system	4,341,925	JSC
Fredercik C. Hallberg and John S. J. Benedicto, NASA/GSFC	Crystal cleaving machine	4,343,287	GSFC
Wilmer H. Reed, III, NASA/LaRC	Decoupler pylon: wing/store flutter suppressor	4,343,447	LaRC
Edwin J. Saltzman, NASA/ARC	Improved low-drag ground vehicle particularly suited for use in safely transporting livestock	4,343,506	ARC
Jerry L. Hudgins, NASA/MSFC	Apparatus for sequentially transporting containers	4,343,584	MSFC
Harry Levin and Larry B. Ford, Caltech/JPL	Thermal reactor and process	4,343,772	NRO/JPL
Liam R. Jackson, NASA/LaRC	Multiwall thermal protection system	4,344,591	LaRC
Taylor G. Wang and Daniel D. Elleman, Caltech/JPL	System for producing gas-filled hollow spheres	4,344,787	NRO/JPL

Space Shuttle Launches for 1982

Orbiter	Launch Date	Launch Site	Payload
*Columbia (OC-102)	March 22	KSC	OSS-1
*Columbia (OC-102)	June 27	KSC	DOD 82-1
Columbia (OV-102)	November 11	KSC	SBS-B, Telesat-E

* Successful launch

Expendable Launches for 1982

Name	Launch Date	Vehicle	Range	Mission Remarks
*RCA-C	January 15	Delta	ESMC	RCA communications. Reimbursable.
*Westar-IV	February 25	Delta	ESMC	Western Union communications. Reimbursable.
*Intelsat V-D	March 4	Atlas Centaur	ESMC	Intelsat communications. Reimbursable.
*Insat 1-A	April 10	Delta	ESMC	India communications. Reimbursable.
*Westar-V	June 8	Delta	ESMC	Western Union communications. Reimbursable.
*Landsat-D	July 16	Delta	WSMC	NASA earth resources applications.
*Telesat-G (Anik-D1).	August 26	Delta	ESMC	Canada communications. Reimbursable.
Intelsat V-E	September 23	Atlas Centaur	ESMC	Intelsat communications. Reimbursable.
RCA-E	November 18	Delta	ESMC	RCA communications. Reimbursable.
Intelsat V-F	December	Atlas Centaur	ESMC	Intelsat communications. Reimbursable.

* Successful launch

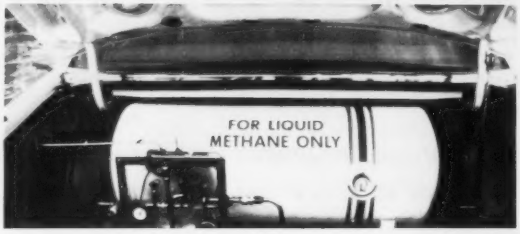
Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at any tiny percentage of the tax dollar. Here is an example:

Alternative Fuel Vehicle

Liquid methane could replace gasoline as a fuel source for automotive vehicles. A principal component of natural gas, methane costs less than one-half as much as gasoline and produces a cleaner emission than either gasoline or diesel fuel. A method of converting cars and trucks to liquid methane operation has been developed drawing upon the space technology used to produce cryogenic storage systems for NASA's Apollo and Skylab spacecraft and for the Space Shuttle.

Liquid methane is a cryogenic fuel that must be stored at a temperature 260 degrees below zero Fahrenheit. Beech Aircraft Corp., Boulder Division*, the designer of the liquid methane system, has received its first substantial contract for vehicle conversion from Northwest Natural Gas Co., Portland—25 vehicle conversions and a liquid methane refueling station. In addition to the 18-gallon fuel tank stored in the trunk, the liquid methane system includes a simple "under the hood" carburetor conversion. An optional twin fuel system is available which enables the operator to use either liquid methane or gasoline.



* NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.

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*U.S. GOVERNMENT PRINTING OFFICE : 1982 0-361-563/504